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UNITED STATES DEPARTMENT OF AGRICULTURE

BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE

FOREST INSECT INVESTIGATIONS

RECONNAISSANCE OF 1936-1937 WINTER MORTALITY OF FOREST INSECTS IN CALIFORNIA

by
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Forest Insect Laboratory
Berkeley, California
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RECONNAISSANCE OF 1936-1937 WINTER MORTALITY OF FOREST INSECTS IN CALIFORNIA.

A reconnaissance of the winter mortality in forest insect broods that resulted from the unusually low temperatures of January 8-10 and January 20-25, was completed between April 5 and 23, 1937. The two cold periods, which affected crops and many native and exotic plants throughout California were particularly severe in the northeastern part of the state. Because of this, most of the field work has been done in northeastern California. Special care has been taken to determine the boundaries of the area of noticeable winter mortality and of adjacent areas in which no appreciable kill resulted from the low temperatures.

Results of the Low Temperatures

Southern California:

In southern California, where a control project and extensive observations by Miller and Patterson from the basis for our conclusions, the low temperatures resulted in no abnormal mortality of overwintering forest insect broods.

Westside subregion:

In the west side areas of the Sierra Nevada Range in Central California some abnormal mortality was found. 15% of the overwintering brood of western pine beetle was killed in one tree near Bass Lake. Temperatures at Wawona reached a minimum of -21° F. in January. It is probable that similar low temperatures were reached at other points in the west side area where air drainage conditions were favorable to the production of localized low temperature conditions. However, these local climatic conditions cannot be considered to be either general or of great importance in modifying infestation trends or intensities. At most United States Weather Bureau Stations located in timber type in this subregion, the air temperatures were not low enough to produce lethal conditions for a large part of the overwintering forest insect population.

Eastside subregion:

In northeastern California, where a more intensive examination of conditions was mae, the following conclusions have been reached as a result of that work:

1. Winter mortality appreciably affected the population of but one primary species, i.e., Dendroctonus brevicomis.

2. The low temperature had no or but a very slight affect on broods of the mountain pine beetle, Jeffrey pine beetle, and flathead borers in eastside areas.

3. Winter mortality of western pine beetle broods is acting in conjunction with a general downward trend by that species and thus may have

infestation

a greater effect than if it were acting against a rising trend.

4. However, field observations made in April and May show that the remaining broods are active and that fairly normal seasonal conditions are resulting in rapid development.

5. In general, D. brevicomis is a relatively minor part of the active forest insect populations in many eastside areas at the present time. Accordingly, it does not appear that the general infestation picture has been modified as much as seems apparent when only the western pine beetle mortality is considered.

General Conclusions

The field work in the eastside subregion was planned so that a general outline of the area of effective mortality could be secured. The route of travel in forested areas is shown in red on the map accompanying this report. The areas in which a noticeable amount of mortality of western pine beetle broods was found is shown in blue on the same map. In many localities within that area a considerable portion of the overwintering broods of forest insect species was found to be unharmed by the low temperatures. Also a considerable variation in mortality, even in adjacent trees and under similar conditions, was found to occur in each locality examined. As a result, presentation of all the details of the 128 examinations that were made would leave a very confused picture of existing field conditions. However, the following general statements and conclusions may be drawn from the field data.

1. The only large forest areas in which it is apparent that the overwintering broods were markedly reduced are the Modoc and Lassen areas.

2. This condition is due chiefly to the presence of fairly large populations of the western pine beetle in those areas.

3. Although Weather Bureau records indicate that temperatures as low as those which occurred in the Modoc and Lassen occurred elsewhere, the abundance of other more resistant species of insects or the lack of heavy infestations reduced the effectiveness of those temperatures.

4. The resistance of forest insects, in order of degree of susceptibility and ranging from the more susceptible to the less susceptible, was found to be about as follows:

More susceptible - Western pine beetle - Dendroctonus brevicomis
Roundhead borer in pine - Graphisurus spectabilis
Fir engraver beetle - Scolytus ventralis
Roundhead borer in fir - Tetropium abietis
Turpentine borer - D. valens
Mountain pine beetle - D. monticolae
Jeffrey pine beetle - D. jeffreyi
Less susceptible - Pine flathead borer - Melanophila californica

5. Young larval stages appeared to be more susceptible to injury than the older larval stages.

6. Although few eggs were seen, most of them were living and appeared to be in good condition.

7. There was a very great spread between bark and air temperatures. At Hackamore, bark thermographs in an infested tree recorded -9° F. on one side of the tree and -3° F. on the other, although air temperatures were below -30° F. Maximum mortality in this tree proved to be 81% by count.

8. Living roundhead larvae above 35 feet and dead roundhead larvae below that level - which was the condition found in one infested tree that was felled at Hackamore - points to the existence of a marked temperature gradient above the surface of the ground.

9. Weather Bureau records only appear to be general indices of the possibility of mortality in overwintering broods of the several species of forest insects concerned in the infestations.

10. Effective mortality seems to vary with and be dependent chiefly on local conditions of air movement, air drainage, exposure, infestation composition and other local factors.

OUTLINE MAP OF NORTHERN CALIFORNIA SHOWING NATIONAL FOREST AND PARK BOUNDARIES

SCALE: 37 mi. = 1 in.

ROUTE OF TRAVEL

AREA OF GENERAL MORTALITY

OREGON
CALIFORNIA
NEVADA
CALIFORNIA
PACIFIC OCEAN
Crescent City
Eureka
Weaverville
Yreka
Redding
Red Bluff
Willitts
Willows
Chico
Marysville
Nevada City
Placerville
SACRAMENTO
Santa Rosa
Clear L.
Lower Klamath L.
Tule L.
Goose L.
Upper L.
Middle L.
Lower L.
Alturas
MODOC NATIONAL FOREST
KLAMATH NATIONAL FOREST
SHASTA NATIONAL FOREST
TRINITY NAT'L. FOREST
MENDOCINO NAT'L. FOREST
LASSEN NAT'L. FOREST
LASSEN VOLCANIC NAT'L. PARK
Eagle L.
Susanville
PLUMAS NATIONAL FOREST
Honey L.
TAHOE NAT'L. FOREST
Lake Tahoe
ELDORADO NAT'L. FOREST
STANISLAUS NAT'L. FOREST
MONO NAT'L. FOREST
Mono L.
YOSEMITE NAT'L. PARK
Yosemite
Sonora
STOCKTON
Merced
SAN JOSE
BERKELEY
OAKLAND
SAN FRANCISCO
FARALLON IS.
MUIR WOODS NAT'L. MON.
SIERRA NAT'L. FOREST
Northfork
Huntington L.
Bishop
INYO NAT'L. FOREST
Madera
FRESNO
GEN. GRANT NAT'L. PARK
SEQUOIA NAT'L. PARK
Owens L.
Salinas
SANTA BARBARA NAT'L. FOREST
San Luis Obispo
Tulare L.
SINK
Porterville
KERN NAT'L. FOREST
BAKERSFIELD
Buena Vista L.
Kern L.
KLAMATH R.
SALMON R.
TRINITY R.
EEL R.
RUSSIAN R.
SACRAMENTO R.
PIT R.
FEATHER R.
YUBA R.
PUTA CR.
COSUMNES R.
MOKELUMNE R.
CALAVERAS R.
STANISLAUS R.
TUOLUMNE R.
MERCED R.
SAN JOAQUIN R.
FRESNO R.
KINGS R.
KAWEAH R.
SAN JUAN CR.
OWENS R.
KERN R.

P.C.J. 1-34

APPENDIX FOR OFFICE FILES

Minimum Temperature records for January 1937 can be seen in Weather Bureau Record for month of January.

Tree Examinations are grouped according to forests or by nearest National Forest. Trees are numbered consecutively.

SHASTA NATIONAL FOREST - Sacramento Canyon Highway

1. Junction of Pit and McCloud Rivers FH ½ - 1L prepupae no mortality.
2. Barnes Camp. FH prepupae - no mortality.
3. Dog Creek FH 0 - ½ L. No mortality. (Five injured)
4. Dog Greek FH ½ - L. Prepupae - no mortality. (Five injured)
5. Pollard Creek. FH ½ - 1 Prepupae - no mortality.
6. Hileoha Springs. DB -½-1. Pupae - no mortality.
7. Hileoha Springs. DB -½-1. Pupae - no mortality.
8. Mt. Shasta-McCloud road. FH ½-1. Prepupae - no mortality (Five injured)
9. Mt. Shasta-McCloud road. FH ½-1. Prepupae - no mortality (Five injured).

SHASTA NATIONAL FOREST - Between Mt. Shasta City and Yreka.

10. 2 mi.N. Mt Shasta DB ½-1. 0-25%kill. DM 0-½. No mortality.
11. ½mi N. of Weed. FH ½-1 prepupae. No mortality.
12. 1 mi S. of Yreka (Several trees) FH ½-1. Prepupae - no mortality.

SHASTA NATIONAL FOREST - Between Weed and MacDoel on Klamath Falls Highway.

13. Andesite DB ½-1 pupae 0-25% kill. FH ½-1 Prepupae - no mortality.
14. Andesite DB ½-1 pupae 0-25% kill FH ½-1 no mortality.
15. Grassy Lake. FH 0-½ between bark and wood 75% kill. ½-1 in bark - no mortality.
16. Grassy Lake. FH 0-½ no mortality.
17. Grassy Lake Slope. DM ½-1 0-25% kill FH ½-1 no mortality
18. Grassy Lake Slope. DM ½-1 75-100%kill FH ½-1 no mortality. } GROUP
19. Grassy Lake Slope. DM½-1 0-25% kill.
20. Butte Creek Summit. DB 0-½ 100% dead. DM ½-1 0-25% kill. FH ½-1 prepupae 0-25% dead. RH ½-1 100% kill.
21. Butte Creek Summit. DB ½-1 100% dead.
22. Butte Creek Summit. DM ½-1 50-75% kill. } GROUP

APPENDIX - #2

23. Butte Creek - Leaf C.C.C. Camp. DM 0-½ 100% kill.

MODOC NATIONAL FOREST. HAPPY CAMP LAVA BEDS AREA.

24. Old Timber Mtn. Road. FH ½-1 no mortality.
25. Old Timber Mtn. Road. FH ½-1 prep. no mortaltty
26. MC 2 - DB ½-1 50-75% kill.
FH ½-1 prep. no mortality.
DM ½-1 25-50% kill
BE 106- at Hackamore DB ½-1 all dead.
RH ½-1 all dead.
BE 107- at Hackamore DB ½-1 all dead.
RH ½-1 all dead except at extreme base under snow.
DM - NA living - few dead
27. MC 2 - DB 0-½ 100% dead.
DM 0-½ no mortality.
28. Top of BE 107 lying under snow all winter
DB ½-1 no mortality.
29. Hackamore. DB ½-1 100% Dead.
31. FH Brood logs at Hackamore. FH ½-1 prep all living.
DM ½-1 100% kill.
32. Quarantine Station Klamath Falls Highway.
DM ½-1 heavy brood 100% kill.
FH ½-1 no mortality.
BE 103 Bark count DB ½-1 66 dead 16 living.
33. Stone crushe[illegible] Lookout Road DB ½-1 100% kill.
112 Horse Camp Well #1 DB ½-1 0-25% Dead
113 " " " " DB ½-1 100% kill. } GROUP
114 " " " " DB ½-1 50-75 kill.
115 Webb Flat Road. DM ½-1 0-25% kill } TOGETHER
116 " " " Db ½-1 50-75% kill.
117 Crank Springs FH ½-1 no mortality.
118 " " DB ½-1 all living.
DM ½-1 all living.
34. Washington Creek. DB 0-½ 100% kill.
RH 0-½ 25% kill.
35. Washington Creek DV - NA 100% kill.
Eggs - no mortality.
½-1 100% kill
36. Associated Oil Siding. DB 0-½ 100% kill
FH Inc 0-½ 50% kill
37. Taylorville. FH prepupal - no mortality.

MODOC NATIONAL FOREST -ADIN MOUNTAIN AREA.

38. Conklin Mill. DJ ½-1 NA all living.
39. Conklin Mill. DJ ½-1 all living.
40. Adin Summit. FH ½-1 prep. All living.
41. Adin Summit. DJ ½-1 all living.
FH ½-1 all living.
42. Rush Creek DB ½-1 0-25% kill.

FH ½-1 prep - all living.
RH ½-1 all living.

43. Rush Creek. FA 0-½ (not in bark) 25-50% dead

BIG VALLEY MOUNTAINS * MODOC AND SHASTA NATIONAL FOREST.
Temperature at Berber -- 35° .

44. Big Valley Mtns. FH ½-1 prep. all living.
DM ½-1 all living.
45. Muck Valley Road. Top of ridge - Foliage all red (winterkill)
cambium brown - no insects.
46. Road to Day. DB ½-1 pupae 25-50% dead.
47. " " " FH ½-1 pre all living.
48. " " " FH 0-½ all living.
49. " " " FH 0-½ all living.
119 Muck Valley RH 0-½ in fire killed material
(Fire Aug 21, 1934) all living.

SHASTA NATIONAL FOREST - MC CLOUD TO FALL RIVER MILLS.

120 5 miles E of McCloud DM ½-1 none dead.
121 Bartle DM ½-1 50% dead.
122 Bear Creek East of Pondosa DB ½-1 no mortality
123 PWA road to Dana. DB ½-1 no mortality.
Rh ½-1 no mortality
124 Timbered Crater DM ½-1 none dead.
125 " " DM ½-1 none dead.
126 Fall River Valley DM ½-1 25% dead
RH ½-1 50% dead.

SHASTA NATIONAL FOREST - ROAD FROM FALL RIVER MILL TO CASSEL.

50. Lava Beds FH prepupal larvae all living.
51. " " DB ATT 0-½ all living.
Inc. FH 0-½ all living.
Note (heavy mortality in this area in 1932)

LASSEN NATIONAL FOREST - HAT CREEK TO VIOLA.

52. Hat Creek DB ½-1 100% kill.
RH ½-1 75-100% kill.
53. Hat Creek DB ½-1 25% kill.
FH ½-1 all living.
54. Hat Creek (Sugar Pine) DV ½-1 25 % dead.
FH 0-½ (Beneath bark) 25% kill

55. Hat Creek. DB ½-1 25-50% kill.
56. Old Station. DB ½-1 0-25% dead.
57. Old Station. DJ 0-½ 25% dead. ½-1 all living FH prepupae - all living.
58. Emigrant Trail. Tetropium ½-1 living. S. ventralis 0-½ ½-1 living.
59. Emigrant Trail. DJ 0-1. 0-25% dead. (Same trees Strong examined)

SHASTA NATIONAL FOREST - RED BLUFF-SUSANVILLE ROAD.

60. Paynes Creek Ridge. FH ½-1 Prepupae all living.
61. " " " . DB ½-1 prepupae. N A all living. FH ½-1 prepupae. All living.
62. Paynes Creek Ridge. Digger pine FH ½-1 pupal - all living.
63. Lassen Camp. DB ½-1 pupal. N A all living.
65. " " . Windfall FH ½-1 prepupal. All living.
66. # " . Douglas fir. FH ½-1 all living.
67. Mineral Summit. Sugar pine DM 0-1 0-25% dead.
68. Mill Creek. DB ½-1 25% dead.
69. Deer Creek. DB ½-1 25-50% dead.
70. " " . DB 0-1 0-25% dead.
71. " " . DB 0-½ 50-75% dead.
72. " " . DJ ½-1. RH ½-1 all living.
73. " " . DJ ½-1. RH ½-1 all living.
74. Westwood. DB 0-1 100% dead.
75. " . DB ½-1 50-75% dead.
76. " . DB ½-1 25-50% dead.
77. " . DB ½-1 25-50% dead.
78. " . DB ½-1 50-75% dead.
80. Coppervale. FH prepupae, all living.
81. Chester. DB 0-½ 0-25% kill. RH 0-½ all living.
82. Westwood. FH prepupal, all living.
83. Quincy road. DB ½-1 0-25% kill. RH ½-1 all living.

PLUMAS NATIONAL FOREST - WESTWOOD TO QUINCY ROAD.

84. Lake Almanor. DB ½-1 25-50% kill.
85. " " . DM 0-½ 0-10% kill.
86. " " . Db ½-1 25-50% kill.
87. Greenville. DB ½-1 50-75% kill.
88. " . DB ½-1 100% kill.
89. " . DB ½-1 100% kill.

QUINCY TO CHILCOOT PASS

90. Taylor Creek. DB ½-1 0-25% kill.
91. Massack. DB 0-½ 100% dead.
92. " . DB eggs - all living.
93. " . DB ½-1 all living.
94. " . DB ½-1 all living.
95. " . DB ½-1 all living.

96. Delleker. FH (JP) prepupae, all living.
97. Dotta Canyon. (WF) FH ½-1 all living. S. ventralis ½-1 75% dead.

TAHOE NATIONAL FOREST - RENO TO TRUCKEE ROAD.

98. Boca. FH prepupal, all living. DB ½-1 100% kill.
99. Boca. DB 0-½ 100% kill. DM 0-½ 50-75% kill. FH 0-½ one found dead, remainder living.
100. Boca. DB ½-1 100% kill. DM pupae, N A 100% kill.
101. Hobarts Mills. (WF) S. ventralis ½-1 100% kill. Tetropium abietis ½-1 100% kill. (Temperature at Hobarts Mills -40° F.)

TRUCKEE TO LAKE TAHOE.

102. Truckee River Canyon. Lodgepole pine. Secondary Ins. adults and ½-1 larvae 100% kill. RH 0-½ 100% kill.
103. Lake Tahoe. (WF) S. ventralis ½-1 0-25% dead.
104. " " . FH ½-1 all living.
105. " " . (WF) S. ventralis ½-1 all living.
106. " " . (WF) S. ventralis ½-1 all living.
107. Truckee River Road. DJ ½-1 0-25% dead.

TRUCKEE TO SACRAMENTO.

108. Donner Summit. (JP) FH prepupal, all living.
109. " " . DJ eggs, all living. FH 0-1 prepupal, all living.
110. Cisco Station. FH prepupal, all living.
111. " " . DJ ½-1 all living. FH prepupal, all living.